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ENGELMANN SPRUCE BEETLE SURVEY
ROUTT, ARAPAHO, and WHITE RIVER NATIONAL FORESTS, COLORADO
(DETAILED REPORT)
1951

(NOT FOR PUBLICATION--FOR ADMINISTRATIVE USE ONLY)

by

W. F. McCambridge

Forest Insect Laboratory
233 Forestry Bldg., Colo. A & M
Fort Collins, Colorado

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AGRICULTURAL RESEARCH ADMINISTRATION
BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE
DIVISION OF FOREST INSECT INVESTIGATIONS

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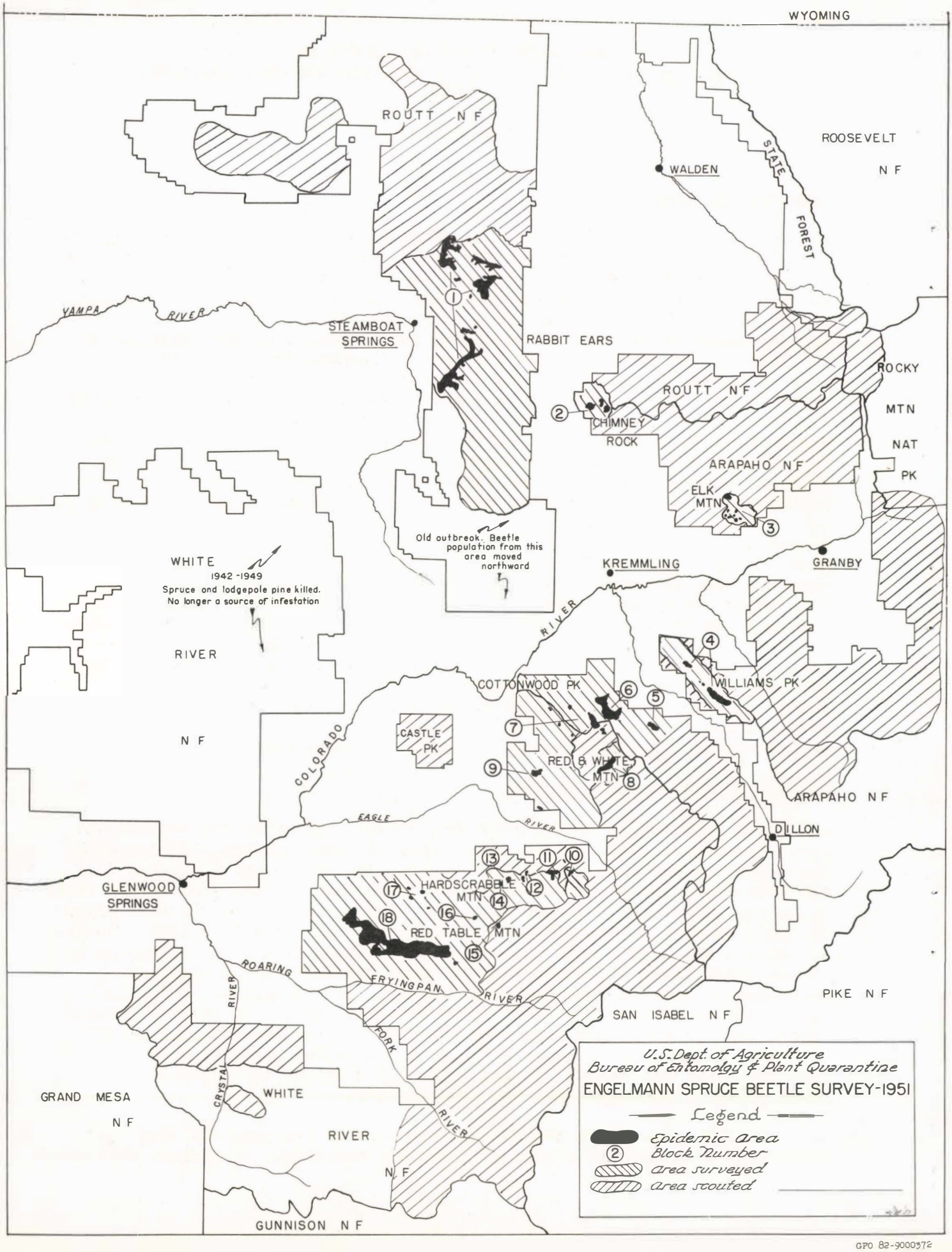

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ENGELMANN SPRUCE BEETLE SURVEY
ROUTT, ARAPAHO, and WHITE RIVER NATIONAL FORESTS, COLORADO
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INTRODUCTION

Previous Outbreaks

Destruction of spruce forests by the Engelmann spruce beetle, Dendroctonus engelmanni Hopk., is not new in the Rocky Mountains. "One of the earliest notes about this insect is by Packard (1877) to the effect that in his surveys of 1875 the beetle was very common in Colorado and was especially common near Blackhawk and Manitou, Colorado. Several years prior to 1907, 70 to 90 percent of the spruce was killed in the Sierra Blanca Mountains of the Lincoln National Forest in New Mexico (Hopkins 1908). In 1905, Hopkins (1906) found evidence of an epidemic that occurred about 50 years prior to that date on the Pike National Forest, particularly on the south slopes of Pike's Peak. A fire followed the epidemic leading the casual observer to believe that the fire was the primary cause of the destruction rather than the beetle. Much destructive work was reported on the Manti National Forest in Utah in 1905 (Hopkins 1906). The beetle was particularly active on the White River National Forest about 20 years prior to 1906 (Hopkins 1906), where it was estimated that 20 percent of the mature spruce was killed in the area between East Elk Creek and Deep Lake. An examination of the infestation on the Grand Mesa in August 1943 showed that a severe epidemic swept the Grand Mesa proper about 75 years ago. The forest floor was covered with old trees with evidence of the beetle galleries on the surface. One of the more recent epidemics occurred about 20 years ago on Boulder Mountain on the Powell National Forest in Southern Utah. The spruce type, limited to about 10 sections and isolated on this mountain top, was completely denuded of merchantable-sized trees. A severe fire followed the epidemic. A severe infestation swept through the northwest portion of Yellowstone National Park from 1933 to 1937, killing 90 percent of the spruce above 10 inches D.B.H. in certain areas (1)."

History of the Present Outbreak

All known previous outbreaks were small in comparison to the present one which started in 1939. In the short span of years between 1939 and 1951 this outbreak has caused a loss of 4.3 billion board feet of timber (2). The present outbreak started in spruce blown down in June 1939 on the White River and Grand Mesa National Forests. Beetle populations which developed in the blow-down material began attacking standing spruce in 1941. However, it was not until 1943 that widespread destruction became alarming, not only on the White River and Grand Mesa Forests, but also on the Gunnison, Uncompahgre, and San Juan National Forests. By the fall of 1943, the spruce timber loss on the White River National Forest had reached 864,300,000 board feet. During this same year the outbreak reached its peak on the Gunnison National Forest with the loss of 1,500,000 board feet of spruce, and died down thereafter. During 1943, infestations were active on the Grand Mesa, Uncompahgre, and San Juan Forests.

In 1944, the outbreak on the Uncompahgre reached its peak and died out shortly thereafter with a loss of 3,000,000 board feet of spruce. Sanitation

logging practices were largely responsible for bringing this part of the outbreak under control. Losses on the Grand Mesa had reached 18,000,000 board feet of spruce, and the San Juan was suffering very heavy losses. The White River Forest lost 919,300,000 board feet of spruce in 1944, bringing the total loss to 1,783,650,000 board feet. Also in 1944, heavy losses (7,600,000 board feet) were noticed on the Routt National Forest. This was the first indication that the outbreak was moving in a northeasterly direction.

By the end of 1945, the outbreak on the San Juan had reached its peak with an estimated loss of 50,000,000 board feet of spruce. In 1946, most of the merchantable spruce on the White River National Forest north of the Colorado River had been killed--2,342,000,000 board feet. The outbreak was now moving to the north and east along the Routt and Arapaho Forests, and subsiding on the Forests south of the White River National Forest.

In 1947, the outbreak had reached its peak on the Grand Mesa with a total loss of approximately 80,000,000 board feet of spruce. Sanitation logging aided considerably in bringing this outbreak under control. During this same year it was noticed that lodgepole pine, which had been resisting attacks by the Engelmann spruce beetle, was being killed as a result of attacks by adults entering the basal portion of these trees for hibernation.

By 1948, most of the merchantable spruce on the White River National Forest north of the Colorado River had been killed. This loss amounted to nearly 3,000,000,000 board feet. In addition, many millions of board feet of lodgepole pine were killed. The outbreak was situated on the Routt and Arapaho Forests south of Rabbit Ears Pass and north of the Colorado River. Only on Castle Peak and Cottonwood Peak had epidemic numbers of beetles crossed to the south of the river. Spruce volume losses on the Routt National Forest had reached approximately 100,000,000 board feet; losses on the Arapaho were still under 50,000,000 board feet.

The general northeasterly movement of the outbreak stopped in 1949 when strong winds out of the northwest pushed the attacking beetles far south of the Colorado River. The 1949 beetle flight extended the outbreak into areas hitherto relatively free of beetle infestations. With the completion of this flight, timber losses reached 100,000,000 board feet of spruce and 10,000,000 board feet of lodgepole pine on the Arapaho, 3,065,000,000 board feet of spruce and 370,000,000 board feet of lodgepole pine on the White River, and 300,000,000 board feet of spruce and 20,000,000 board feet of lodgepole pine on the Routt National Forest. It is estimated that spruce volume losses in 1950 on the three Forests amounted to 220,000,000 board feet, and an additional 20,000,000 feet were killed in 1951. Lodgepole pine losses during the two-year period amounted to 100,000,000 board feet, confined chiefly to the White River and Routt National Forests. The above itemized losses amount to 3,839,500,000 board feet of spruce and 500,000,000 board feet of lodgepole pine, or a total loss of both species on all Forests since 1939 of slightly over 4.3 billion board feet.

Factors Affecting Control of the Outbreak

The seriousness of the outbreak was recognized in the fall of 1942 (3). In 1943, Dr. N. D. Wygant of the Forest Insect Laboratory at Fort Collins

made the first extensive appraisal of the situation (4). In 1944, Dr. C.L. Massey began studies of the life history and habits of the Engelmann spruce beetle and initiated research with the aim of developing a satisfactory and economical method of controlling the beetle by chemical means (5). Beginning in 1944, annual surveys were conducted in the epidemic areas (6, 7, 8, 9, 10, 11, 12, 13, 14) to determine the location and trend of the outbreak. This work was started by T. T. Terrell. By the end of 1945, the life history of the beetle had been determined and the progress on control research was encouraging. Orthodichlorobenzene and benzene hexachloride in fuel oil showed considerable promise. But, during the years between 1943 and 1949 the outbreak was so large as to be beyond control. Annual surveys to map the progress of the outbreak and measure its destructiveness were still being conducted in 1949 (15, 16). The survey findings that year uncovered two significant developments: (1) A tremendous beetle flight had moved south across great open areas into vast continuous bodies of spruce, hitherto nearly free from beetle attack. Had the normal southwest winds prevailed at the time of beetle flight, it was hoped that the outbreak, in continuing its northeast spread, eventually would have died out in the lodgepole pine forests along the Gore Range and adjacent to North Park. When the major beetle flight in 1949 was to the southeast, it extended the easterly moving front by 30 miles, and in addition, placed the outbreak in spruce forests which were almost unbroken over the old Holy Cross National Forest and adjacent to the San Isabel and Gunnison National Forests. (2) Enormous numbers of beetles died while enroute across extensive sagebrush areas.

Because of tremendous beetle mortality, it was realized that the outbreak had been reduced and was at its lowest level in years. Furthermore, the threat to the remaining green spruce forests was increased by the extension of the outbreak front. Considering these developments, the Bureau of Entomology and Plant Quarantine and the Forest Service jointly recommended that immediate action be taken to protect the remaining spruce stands.

To obtain the operational information necessary to conduct a control program in the high Engelmann spruce forests, a pilot program was set up on Basalt Mountain during September 1949. The procedures and methods outlined proved to be generally sound and furnished the necessary "know-how" to conduct a full-scale control project.

The Control Program

During the fall of 1949, a program was set up to treat 650,000 infested trees (Castle Peak excluded) and a request for $2,885,000 was made to Congress. In June of 1950, $2,000,000 were appropriated and that year 784,000 trees were treated (Castle Peak included) (20). The fall survey in 1950 (17) found 1,546,600 infested trees, for the most part much smaller in diameter than those infested in 1949. A request for $3,895,000 was made to treat these trees.

During the winter of 1950-51, a severe cold wave hit the western slope of Colorado. Temperatures as low as -49°F. in Kremmling, and -56°F. in Eagle were recorded. This cold weather killed the beetle populations in thousands of the trees infested in 1950 (18), and caused the woodpeckers to feed at the bases of trees on living larvae that had been protected by snow.

On August 20, 1951, Congress appropriated $1,000,000 to continue the fight against those beetles which had escaped the cold and woodpeckers; approximately 200,000 trees were treated in all of the major areas of lowest winter mortality.

TABLE 1.--Summary of Control in 1950 and 1951

Area	Trees Treated in 1950	Estimate of Trees to Treat in 1951 [1]	1950-1951 Winter Mortality of Larvae in Percent [2]	Trees Treated in 1951 [3]
Sherman Cr.	418	-----	-----	-----
Bill Cr.	2,167	-----	-----	-----
Parkview Mtn.	797	-----	-----	-----
Chimney Rock	26,462	15,000	98.67 ± .48	0
Willow Cr.	13,944	2,000	-----	0
Elk Mtn.	10,772	14,000	95.00 ± 1.50	0
Fool Cr.	296	470	100.00	0
Cottonwood Peak	168,642	252,000	64.09 ± 3.90	93,743
Elliot Cr.	32,583	46,000	92.68 ± 2.81	0
Williams Ridge	31,552	33,000	96.00 ± .84	0
Red and White Mtn.	89,224	137,000	77.00 ± 3.70	22,629
Red Sandstone and Spraddle Cr.	4,420	-----	-----	-----
Hardscrabble Mtn.	206,213	98,700	76.45 ± 2.66	75,174
Red Table Mtn.	58,831	476,000	81.87 ± 1.66	1,916
Basalt Mtn.	25,592	18,000	99.94 ± .01	0
West Lake	2,093	4,600	------	0
Castle Peak	110,076	164,000	98.17 ± .87	0
U.S. 40 to Luna Lake	-----	205,000	high but variable	5,540
	784,082	1,465,770		199,002

1/ Within the major infested areas.
2/ Mortality from various natural causes.
3/ Where 0 is shown, winter mortality was sufficient to reduce the outbreak to such a low level that no immediate threat to the remaining green spruce was indicated.

In preparation for a continuation of the control program through 1952, a survey of the outbreak was made after beetle flight in 1951. The results of this survey are discussed in the following pages.

As a step toward destroying part of the beetle population, a program of trap-tree and trap-log establishment and handling was initiated in 1951. This was based upon the studies made by Massey in 1949 (19). Suggested locations for laying trap-trees and trap-logs were made during and following the survey.

Method of Survey

The field survey in late summer and early fall of 1951 was divided into two divisions of activity, namely, scouting and surveying. The objective of scouting was to locate, delineate, and map all epidemic areas. The objective of surveying was to determine the number of infested trees per acre, determine the size of the area infested, compute a reliable estimate of the total number of infested trees within predetermined limits of error, and map the concentrations of infested trees.

The method of scouting was essentially one of examining the most susceptible stands of spruce. Spruce in creek bottoms, adjacent to wet sites and in the heads of draws, was examined first. If infested trees were not found in such areas, the next drainage away from the outbreak was examined. All infested trees were counted and mapped, and if the infestation was over 10 acres in size, the area was surveyed.

The method of surveying was to collect data from 1/10-acre circular plots established on parallel lines across the epidemic areas, except in areas of 10 acres or less. Intensity of survey coverage was as follows:

Size of Epidemic Area, in Acres	Percent Survey	Dist. Between Plots, in Chains	Dist. Between Lines, in Chains
1--10	100.00	-----	-----
10--500	5.00	2	10
500--1,500	2.50	2	20
1,500--15,000	1.25	2 or 4	40 or 20
over 15,000	0.60	4	40

The above survey design, based on statistical analysis of the 1950 survey data, was set up to achieve accuracy within 25 percent error at the 68 percent level. The 1951-survey followed the design; in most instances the desired accuracy was obtained. The design was developed jointly by F. B. Knight and W. F. McCambridge of the Forest Insect Laboratory, Fort Collins, Colorado. Knight also outlined the methods of statistical analysis and directed the analyses of data.

The tally taken on each plot was as follows: (a) number of 1951 fully-infested trees, (b) number of 1951 partially-infested trees, (c) number of 1950-attacked trees containing basal fill-in attacks in 1951, (d) timber type, (e) degree of woodpecker feeding on 1950- and 1951-beetle populations, (f) remarks about the intensity and development of 1950- and 1951-beetle populations, and (g) the number of green spruce 10" D.B.H. and larger (taken on every fifth plot).

The following definition of attacks was used:

(a) Number of 1951 fully-infested trees, "Full Attacks." These trees were infested in over 50 percent of their circumferences by 1951-attacking beetles. Heights of attack were not considered.

(b) Number of 1951 partially-infested trees, "Partial Attacks." These trees were infested in less than 50 percent of their circumferences by 1951-attacking beetles. Heights of attack were not considered.

(c) Number of 1950-attacked trees containing basal fill-in attacks in 1951, "Basal Fill-ins." These trees were infested in 1950 either as full or partial attacks, and have been reinfested in 1951 in the moist basal portions only. The height of such fill-in attacks ranges from a few inches above the root colar to approximately 2 feet. Beetle production is generally light in these trees.

The field survey covered approximately 2.4 million gross acres of land, of which approximately one-third contains some spruce timber. The survey required 854 man-days of actual field work. For comparative purposes, the acreages surveyed in 1950 and in 1951 are listed in Table 2.

TABLE 2.--Areas and Acreages Surveyed in 1950 and in 1951

Epidemic Areas Requiring Survey in 1950	Acres	Epidemic Areas Requiring Survey in 1951 (1)	Acres
Routt National Forest			
Ficks Sawmill	10	--(2)	---
Diamond Park	20	--(2)	---
Gilpin Cr.	67	--(2)	---
Rabbit Ears	14,143 (net)	Rabbit Ears	15,000 (net)
Arapaho National Forest			
Chimney Rock	2,340	Chimney Rock (3)	1,330
N.W. Hyannis Pk.	57	--(2)	---
E. Fk. Arapaho Cr.	15	--(2)	---
Coyote Cr.	50	--(2)	---
N.E. Bundy Lakes	65	--(2)	---
Buffalo Cr.	38	--(2)	---
Rock Cr.	13	--(2)	---
Willow Cr.	4,500	--(3)	---
Radial Mtn.	34	--(2)	---
Little Jack Cr.	1,090	--(2)	---
Bowen Gulch	40	--(2)	---
Bennay Mtn.	1,280	--(2)	---
Elk Mtn.	1,200	Elk Mtn. (3)	2,344
Pool Cr.	40	--(3)	---
Beaver Cr.	304	--(2)	---
Strawberry Cr.	33	--(2)	---
Kelly Cr.	4	--(2)	---
Little Muddy Cr.	112	--(2)	---
Keyser Cr.	185	--(2)	---
Williams Pk.	2,700	Williams Pk. (3)	2,990
South Brush Cr.	300	--(2)	---
Slate Lake	240	--(2)	---
Black Lake	200	--(2)	---
Surprise Lake	1,100	Surprise Lake (2)	1,280
Elliot Cr.	4,400	Elliot Cr. (3)	4,218
Cottonwood Pk.	7,500	Cottonwood Pk. (3)	7,574

Epidemic Areas Requiring Survey in 1950	Acres	Epidemic Areas Requiring Survey in 1951 (1)	Acres
White River National Forest			
Slate Mtn.	628	Meadow Cr. (Slate Mtn.)	973
Red Sandstone	40	--(3)	---
Middle Cr.-Spraddle Cr.	157	--(3)(2)	---
Red & White Mtn.	7,360	Red & White Mtn.(3)	3,557
Game Cr.	40	--(2)	---
Two Elk Cr.	3	--(2)	---
Willow Cr.	130	--(2)	---
Benson's Logging Op.	10	--(2)	---
Hornsilver Mtn.	5	--(2)	---
Grouse Lake	1,176	Stone Cr.	870
	)	Beaver Lake	795
Middle Lake	5,793	West Lake-East Lake	300
Porphyry Mtn.	4,144	Squaw Cr.	524
Salt Cr.	380	Triangle Park	237
Hat Cr.	1,745	East Brush Cr.	315
West Brush Cr.	407	--(1)	---
-------	---	Mount Eve	20
Hardscrabble Mtn.	2,500	Hardscrabble Mtn. (3)	718
Red Table Mtn.	16,372	Red Table Mtn.(3)(2)	16,370
Basalt Mtn.	1,500	--(3)	---
Kobey Park	1,000	--(2)	---
Thomas Lake	1,980	--(2)	---
Castle Pk.	4,300	--(3)(2)	---
Booth Cr.	60	--(2)	---
Mill Cr.	10	--(2)	---
Total	91,820	Total	59,415

(1) All of the areas surveyed in 1950 were scouted or surveyed in 1951.
(2) Epidemic brought under control by natural factors.
(3) Epidemic brought under control or greatly reduced by artificial means.

Survey Personnel

Detailed from the Division of Forest Insect Investigations (other than from Fort Collins, Colorado), Bureau of Entomology and Plant Quarantine, United States Department of Agriculture:

A. T. Drooz, Forest Insect Laboratory, New Haven, Connecticut
E. P. Merkel, Forest Insect Laboratory, Asheville, North Carolina
R. H. Smith, Forest Insect Divisional Office, Beltsville, Maryland
Boyd Wickman, Forest Insect Laboratory, Berkeley, California

Detailed from the Division of Plant Disease Control, Blister Rust Control, Bureau of Entomology and Plant Quarantine, United States Department of Agriculture:

Lyle Hansen, Berkeley, California
C. M. Julian, Berkeley, California
Lee Paine, Berkeley, California

The Fort Collins Forest Insect Laboratory wishes to express its gratitude to all of the men detailed from the other offices. We appreciate the personal sacrifices they made and the hardships incurred by their laboratories when they left during the course of their own summer programs.

From the Forest Insect Laboratory, Bureau of Entomology and Plant Quarantine, United States Department of Agriculture, Fort Collins, Colorado:

Permanent—
Fred B. Knight
W. F. McCambridge

Temporary—
C. D. Barnes
R. H. Beal
D. L. Bock
D. J. Boyd
P. Brock
D. K. Brown
D. L. Brown
L. M. Cress
J. L. Correll
J. R. Davis
W. R. Finley
L. M. Finnell
R. W. Graves
C. J. Hay
J. D. Houston
F. T. Hutchison
G. Janssen
J. A. Knopf
J. E. Mills
D. L. Miller
G. G. Morris
G. V. Nishimoto
R. D. Owen
R. A. Payne
J. A. Quist
P. L. Ray
B. J. Santistevan
A. F. Schulz
G. H. Sherrick
D. H. Short
R. E. Smith
J. L. Taylor
J. A. Winter

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Kremmling Control Area

Summary

The Engelmann spruce beetle outbreak in the Kremmling control area has been greatly reduced in size and intensity as a result of artificial and natural control of the 1949- and 1950-beetle populations. During 1951 the outbreak did not move into any areas which were not infested in 1950. All of the 1950-epidemic areas were examined, but only seven were found to be epidemic in 1951. The small outlying infestations found in 1950 on the Routt and Arapaho National Forests, more or less resident in nature, had been brought under control by natural factors. The more aggressive outbreaks in the Chimney Rock area and in Willow Creek were brought under control by artificial means in 1950, as was the small outbreak in Fool Creek.

The 1951 survey results are summarized below:

Block 1/	Name	Acres	Numbers of 1951-Infested Spruce: Full Attacks	Partial Attacks	Basal Fill-ins
1	U.S. 40 to Luna Lake	36,200	39140 ± 6270	9780 ± 2190	42360 ± 7630
2	Chimney Rock	1,330	280 ± 80	440 ± 210	2500 ± 480
3	Elk Mountain	2,344	1960 ± 350	1030 ± 260	4640 ± 980
4	Williams Ridge	2,990	2000 ± 450	1490 ± 270	4180 ± 1100
5	Surprise Lake	1,280	850 ± 270	630 ± 120	920 ± 390
6	Elliot Creek	4,218	1690 ± 1010	840 ± 227	2100 ± 590
7	Cottonwood Peak	7,574	8630 ± 1970	5300 ± 1244	14400 ± 3940
	Total	55,936	54550 ± 6830	19510 ± 1407	71100 ± 4384

1/ Block locations shown on the large map.

Of the above numbers of infested trees, it is expected that all full and partial attacks and approximately one-third of the basal fill-ins will need treatment in 1952. These total approximately 100,000 1951-infested trees.

Descriptions of the Infestation by Blocks

Block 1 - U.S. 40 to Luna Lake

Acres	Full Attacks	Partial Attacks	Basal Fill-ins
36,200	39,140 ± 6,270	9,780 ± 2,190	42,360 ± 7,630

Trees Treated in 1950	Estimate of Trees to Treat in 1951	1950-1951 Winter Mortality of Larvae, in Percent	Trees Treated in 1951
0	205,000	high but variable	5,540

The outbreak has not moved into any new areas which were not infested in 1950. The major concentrations of 1951-attacks were found in the better spruce stands in creek bottoms and on wet sites from Walton Creek to Luna Lake. Lighter infestations of a more scattered nature were found from

Rabbit Ears Peak to Rainbow Lake. Scattered 1951-infested trees occur throughout the area from Highway U.S. 40 to Luna Lake--Rainbow Lake.

Approximately 50 percent of the 1950-attacked spruce contain no beetle populations. This reduction was caused by woodpecker feeding and cold temperatures. A notable exception was found adjacent to Horse Thief Peak near Luna Lake. In this area there are 4,760 ± 840 1950-infested trees on 1,400 acres. These trees contained large numbers of hibernating adults in their basal portions. Scattered throughout the general area from Highway U.S. 40 to Buffalo Pass are similar areas of heavy 1950-hibernation.

The 1951-beetle populations appeared normal in number and development. Woodpeckers had started to feed on these populations above the basal 6 feet.

Adequate green spruce remains in the infested areas to absorb any flight occurring in 1952.

North of a line between the Middle Fork of Mad Creek and Mt. Ethel are numerous areas that were heavily infested in 1949. In most of these areas there has been a very sharp decline in the number of infested trees from 1949 to 1951. For the most part these small infested areas are no longer a threat to outbreak continuation. However, in Burn Creek one infestation was found that is still potentially dangerous. A 100-percent count found 81 1950-attacks and 11 1951-attacks. All trees contained good beetle populations.

While a tremendous drop in numbers of attacks has taken place, there is no guarantee that this drop will continue through 1952. A detailed scouting map has been prepared for the area from Mad Creek to Wyoming. On this map has been plotted every infested tree found on the scouting routes.

Block 2--Chimney Rock

Acres	Full Attacks	Partial Attacks	Basal Fill-ins
1,330	280 ± 80	440 ± 210	2,500 ± 480
Trees Treated in 1950	**Estimate of Trees to Treat in 1951**	**1950-1951 Winter Mortality of Larvae, in Percent**	**Trees Treated in 1951**
26,462	15,000	98.67 ± .48	0

The outbreak has been greatly confined in area and intensity. The 1951-attacks were spotty and found in conjunction with 1950-attacks in the spruce stands of largest diameters.

The 1951-beetle populations were normal in number and development in full attacks and generally heavy in the partial attacks; beetle populations in basal fill-ins were light. Woodpecker feeding has been very heavy on

1949- and 1950-beetles, and was moderate to light on the 1951-beetles in late September. All of the trees infested in 1951 are large.

The 1950-beetle populations have been very greatly reduced in numbers as a result of artificial control, woodpeckers, and cold temperatures. The threat to green spruce from the 1950-beetles will be slight in 1952.

Adequate green spruce trees of large diameters remain in the area to absorb any flight occurring in 1952.

U.S. 40 South to Buffalo Park

This area lies just south of Block 1 and west of Block 2. To determine an estimate of the potential beetle flight in 1952 and the number of trees infested in 1951, 807 sample plots were examined in this area in early October.

The 1950-beetle populations have been eliminated from approximately 60 percent of the trees because of natural control factors. In the remaining 40 percent of the 1950-attacked trees, beetle hibernation was very light in 94 percent of the trees. As a rough estimate, it would require the beetles from between 10 and 20 of these 1950-trees with light brood to fully infest one tree in 1952.

The 1951-beetle populations were generally lighter than normal. Approximately two trees per acre were infested in 1951. Adequate green spruce trees remain in the area to absorb any flight occurring in 1952.

South of Buffalo Park on the Gore Range the infestation has run its course. Very little green spruce was left to be infested in 1951. This area is no longer a serious threat to continued spread of the outbreak.

Block 3--Elk Mountain

Acres	Full Attacks	Partial Attacks	Basal Fill-ins
2,344	1,960 ± 350	1,030 ± 260	4,640 ± 980

Trees Treated in 1950	Estimate of Trees to Treat in 1951	1950-1951 Winter Mortality of Larvae, in Percent	Trees Treated in 1951
10,772	14,000	95.00 ± 1.50	0

The outbreak has declined in size and intensity. The 1951-attacks were found in scattered groups confined to the lower portions of the western side of Elk Mountain and the north side of Corral Peak.

In most areas "pitching out" of the 1951-attacking beetles was heavy. When occasional successfully infested trees were found, the 1951-beetle populations were moderate or sometimes heavy.

The 1950-beetle populations were light to non-existent as a result of artificial control, woodpeckers, and cold temperatures.

The Forest Service plans to fell 500 trap-trees (13) on Elk Mountain before the beetle flight in 1952.

Block 4--Williams Ridge

Acres	Full Attacks	Partial Attacks	Basal Fill-ins
2,990	2,000 ± 540	1,495 ± 270	4,180 ± 1,100

Trees Treated in 1950	Estimate of Trees to Treat in 1951	1950-1951 Winter Mortality of Larvae, in Percent	Trees Treated in 1951
31,552	33,000	96.00 ± .84	0

The outbreak has declined considerably in intensity and somewhat in area. The 1951-attacks were found in groups scattered throughout the spruce type in conjunction with 1950-attacks.

The 1951-beetle populations were light to moderate in full attacks, light in partial attacks, and light in basal fill-ins. Woodpecker feeding on 1951-larvae was light in mid-September. On many occasions it was observed that woodpeckers had taken the parent adults before all of the eggs were laid.

Untreated 1950-attacked trees for the most part contained very few beetles as a result of woodpecker feeding. However, occasional groups of trees were found on the lower slopes in which beetle hibernation was moderate.

The Forest Service plans to fell between 500 and 1,000 trap-trees along the ridge before the beetle flight in 1952.

Block 5--Surprise Lake

Acres	Full Attacks	Partial Attacks	Basal Fill-ins
1,280	850 ± 270	630 ± 120	920 ± 390

The outbreak has declined in intensity as testified by the fact that the 1951-attacks were found in scattered groups rather than evenly distributed throughout the forest.

The 1951-beetle populations were light to moderate in full and partial attacks, and light in basal fill-ins. Woodpecker feeding on these populations was light in early September.

The 1950-beetle populations were light with only an occasional tree containing moderate numbers of hibernating beetles. Woodpecker feeding has been moderate.

Adequate green spruce remains in the area to absorb any flight in 1952.

Block 6--Elliot Creek

Acres	Full Attacks	Partial Attacks	Basal Fill-ins
4,218	1,690 ± 1,010	840 ± 70	2,100 ± 590

Trees Treated in 1950	Estimate of Trees to Treat in 1951	1950-1951 Winter Mortality of Larvae, in Percent	Trees Treated in 1951
32,583	46,000	92.68 ± 2.81	0

The outbreak has been greatly reduced in size and intensity as a result of control operations in 1950. Newly-infested trees are sparsely scattered within the best spruce stands.

The 1951-beetle populations were light to moderate in full attacks, and light in partial and basal fill-in attacks. Woodpecker feeding was light in September.

Untreated 1950-attacked trees contained very few beetles, although woodpecker feeding was only moderate. Winter mortality in the area was generally good.

Over 1,000 trap-trees have been felled throughout the area. All of these trees are very accessible for either removal by loggers or for control treatment in place.

Block 7--Cottonwood Peak

Acres	Full Attacks	Partial Attacks	Basal Fill-ins
7,574	8,630 ± 1,970	5,300 ± 1,290	14,400 ± 3,940

Trees Treated in 1950	Estimate of Trees to Treat in 1951	1950-1951 Winter Mortality of Larvae, in Percent	Trees Treated in 1951
168,642	252,000	64.09 ± 3.90	93,743

The outbreak has been greatly reduced in size and intensity as a result of control operations. Winter mortality, however, was variable and, in general, so low that considerable artificial control had to be carried out in 1951.

West of Cottonwood Peak-Piney Peak the 1951-attacks were generally light with only scattered groups of trees normally infested. Very few 1951-infested trees were found northwest of Lone Lick Lakes, but some groups of normally infested trees were found south of the Lakes. No serious beetle flight occurred toward the head of Sheephorn Creek or immediately over the Piney Divide.

The 1951-beetle populations were normal and woodpecker feeding on the larvae was light in September.

The 1950-beetle populations were heavy in the limited untreated areas. If at all possible, the infested trees should be treated before the flight in July 1952. Woodpecker feeding on the 1950-beetle populations was moderate to heavy.

No appreciable amount of green spruce can be found northwest of Lone Lick Lakes. Adequate green spruce remains in the area east of Beaver Dam Lake and at the head of Sheephorn Creek to absorb the beetle flight in 1952.

Over 1,000 trap-trees have been felled in these last mentioned areas, and it is recommended that a few small groups of trap-trees be felled approximately 3/4 and 1 mile south of Piney Divide.

Scouting

Map 1 shows the areas covered by scouting. No serious concentrations of 1950- or 1951-infested trees were found. The small outlying epidemics found in 1950 have been brought under control either by artificial or natural means. In all instances, the numbers of 1951-infested trees were far below the numbers occurring in either 1949 or 1950.

Fourteen 1950-infested trees (seven of which are windfalls) were found in the Middle Fork of the Michigan River adjacent to Colorado Highway 14 at the point where the road leaves the main river drainage. All of these trees contained very heavy beetle populations.

Rocky Mountain National Park

Columbine Creek--While no serious infestation exists here, the situation is worthy of mention. For a number of years the large over-mature spruce in this boulder-filled, thin-soiled creek bottom has been sustaining a high annual timber loss because of windthrow. The down timber has provided suitable breeding material for the Engelmann spruce beetle, and, as a consequence, a high resident beetle population has remained in the area, continually attacking the fresh windfalls, and occasionally killing standing trees. In 1949 and in 1950 there was a noticeable increase in the number of standing trees being killed. However, at that time there was also an increase in woodpecker feeding. This factor, combined with extremely cold temperatures during the winter of 1950-51 resulted in a complete halt to a situation that was becoming serious.

The infestation had extended up Columbine Creek, a distance of approximately 2 miles from the end of the trail. The average width was approximately 10 chains. Trees infested in 1949 and 1950 extended in small groups throughout this distance. Approximately 400 trees were examined. No 1950-beetles were found and no trees not attacked in 1950 were infested in 1951. The number of 1950-trees containing 1951-attacks was very small. A fair proportion of the 1951-fill-in attacks contained good brood, but woodpeckers were already feeding moderately, and in many cases, had eaten the adults before egg galleries were completed. Many of the new windthrown trees were infested along the underside, but attacks were light. It is felt that the infestation is not moving at present.

Roaring Fork--Just over the ridge from the head of Columbine Creek, at the head of the west fork of Roaring Fork Creek is a small resident infestation of about 6 acres. This infestation had held its own for a number of years but is now on the decline. No 1951-attacks were found. About one-half of the 1950-infested trees contained some hibernating adults. Woodpecker activity was not heavy in the area. (It is possible that this small infestation may be on the Arapaho National Forest).

Eagle Control Area

Summary

The Engelmann spruce beetle outbreak in the Eagle control area also has been greatly reduced in intensity as a result of artificial and natural control. With the exception of 315 acres in East Brush Creek, the outbreak did not move into any new areas which were not infested in 1950. Many of the small outlying infestations were brought under control by woodpeckers, cold temperatures, and chemical treatment. The remaining infested areas continue to be a serious threat to adjacent stands of green spruce, and all, with the exception of Hardscrabble Mountain and Red and White Mountain, are difficult to reach.

The 1951 survey results are summarized below:

Block [1]	Name	Acres	Number of 1951-infested Spruce: Full Attacks	Partial Attacks	Basal Fill-ins
8	Meadow Creek	973	1670 ± 505	640 ± 155	550 ± 230
9	Red and White Mtn.	3,557	5650 ± 920	4840 ± 960	6080 ± 1100
10	Stone Creek	870	520 ± 220	350 ± 140	260 ± 150
11	Beaver Lake	795	4680 ± 1110	1330 ± 470	950 ± 300
12	West L.-East L.	300	1060 ± 360	625 ± 230	690 ± 110
13	Squaw Creek	524	315 ± 130	315 ± 140	545 ± 60
14	Triangle Park	237	200 ± 30	0 ± 0	0 ± 0
15	East Brush Creek	315	1510 ± 720	280 ± 130	280 ± 170
16	Mount Eve	20	300 ± 80	80 ± 25	110 ± 45
17	Hardscrabble Mtn.	718	3550 ± 2370	140 ± 100	720 ± 620
18	Red Table Mtn.	16,370	57130 ± 8330	15400 ± 2230	55490 ± 6380
		24,679	76585 ± 8862	24000 ± 2470	65675 ± 6506

[1] Block locations shown on the large map.

From the above numbers of infested trees, it is expected that all full and partial attacks, and approximately one-third of the basal fill-ins, will need treatment in 1952. These total approximately 125,000 1951-infested trees that may require treatment in 1952. Of this number approximately 93,000 are on Red Table Mountain.

Descriptions of the Infestation by Blocks

Block 8--Meadow Creek

Acres	Full Attacks	Partial Attacks	Basal Fill-ins
973	1,670 ± 505	640 ± 155	550 ± 230

The 1951-infestation has not moved outside of the areas attacked in 1950. The major portion of the outbreak, situated on 973 acres, is concentrated in the best spruce type along creek bottoms and wet sites at the head of Meadow Creek.

The 1951-larval populations in all categories of attacks were relatively heavy. Woodpecker feeding on these larvae was light at the time of the survey.

The 1950-beetle populations were generally light, but enough trees contained hibernating adults to continue the infestation. An estimated 1,120 ± 380 treatable 1950-attacks were found. Woodpecker feeding on the 1950-beetles was moderate to heavy in October.

Adequate green material remains in the area to absorb the 1952 flight. The best approach to this area was found to be over Piney Divide from the north and then east of Slate Mountain.

Block 9--Red and White Mountain

Acres	Full Attacks	Partial Attacks	Basal Fill-ins
3,557	5,650 ± 920	4,840 ± 960	6,080 ± 1,100

Trees Treated in 1950	Estimate of Trees to Treat in 1951	1950-1951 Winter Mortality of Larvae, in Percent	Trees Treated in 1951
89,224	137,000	77.00 ± 3.70	22,629

The 1951-beetle flight did not extend the outbreak into any areas not infested in 1950. The most serious concentrations of beetles were east of the lower portion of the South Fork of Piney Creek, and just west of the head of Rock Creek. Both of these areas are beyond the 1951-treating areas.

The 1951-beetle populations were generally light in full and partial attacks, and very light in the basal fill-ins. Woodpecker feeding was light.

The majority of untreated 1950-attacked trees contained few hibernating beetles. However, some trees contained normal quantities of hibernating adults and some flight can be expected in 1952, especially in the South Fork of Piney Creek area. Woodpecker feeding on the 1950-attacks was moderate to heavy.

Green spruce trees are abundant toward the eastern side of the outbreak area.

Block 10--Stone Creek

Acres	Full Attacks	Partial Attacks	Basal Fill-ins
870	520 ± 220	350 ± 140	260 ± 150

The 1951-infestation is chiefly confined to the creek bottom, with some infested trees on the slope to the east. The 1951-attacked trees are in groups, more or less adjacent to the 1950-attacks.

The 1951-beetle populations were light to moderate, as was woodpecker feeding.

Some 1950-attacked trees contained abundant beetle populations although woodpecker feeding was generally heavy.

Adequate mature spruce remains in the creek bottom areas to absorb any local flight in 1952.

Some scattered, infested trees were found in West Grouse Creek, but no large quantities of beetles were seen.

Block 11--Beaver Lake

Acres	Full Attacks	Partial Attacks	Basal Fill-ins
795	4,680 ± 1,110	1,330 ± 470	950 ± 300

The 1951-infested trees were found in association with trees infested in 1950 and the infestation rate is the same. Concentrations of infested trees were found on the ridge west of Beaver Lake, in scattered groups south of the lake up Beaver Creek, and on the ridge about 1 mile east of the lake.

The 1951-beetle populations varied from light to heavy, but, in general, they were lighter than those produced in 1950. Woodpecker feeding was light.

Some of the trees infested in 1950 contained large numbers of hibernating adults. Such trees are those of largest diameters, and were found scattered throughout the area.

Adequate green spruce remains in the area to absorb any local flight in 1952.

Block 12--West Lake-East Lake

Acres	Full Attacks	Partial Attacks	Basal Fill-ins
300	1,060 ± 360	625 ± 230	690 ± 110

This infestation is situated on the very steep slopes east of West Lake Creek about 1 mile north of Barida Cabins, and on the ridge between East Lake Creek and West Lake Creek at the northern extremity of spruce type. Trees infested in 1951 are distributed somewhat evenly throughout the better spruce stands. The per acre intensity of 1951-attacks was about one-half the intensity of 1950-attacks.

The 1951-beetle populations were normal in full attacks, but tended to be light in partial and basal fill-in attacks. Woodpecker feeding on the 1951-beetles was light in September.

The 1950-beetle populations have been greatly reduced as a result of woodpecker feeding and cold temperatures; however, scattered trees contained many hibernating adults. Woodpecker feeding has been moderate on the 1950-beetles.

Adequate green spruce remains in the area to absorb any local beetle flight in 1952.

The area in West Lake Creek is inaccessible to all forms of transportation and is hazardous for foot travel.

Block 13--Squaw Creek

Acres	Full Attacks	Partial Attacks	Basal Fill-ins
524	315 ± 130	315 ± 140	545 ± 60

The 1951-infestation on the ridge east of Squaw Creek has been greatly reduced in size and intensity. The newly-infested trees are scattered in the better spruce stands.

The 1951-beetle populations were light in all categories of attacks. Woodpecker feeding was light in September.

The 1950-beetle populations were very light in the areas untreated in 1950. Woodpecker feeding had been moderate to heavy on these populations.

Adequate green spruce remains in the area to absorb any local beetle flight in 1952. A small number of trap-trees might be felled to advantage in this area.

Block 14--Triangle Park

Acres	Full Attacks	Partial Attacks	Basal Fill-ins
237	200 ± 30	0 ± 0	0 ± 0

This infestation lies at the head of Salt Creek and south of the sawmill in Squaw Creek. The 1951-infested trees were found in the same area with the 1950-attacks.

The 1951-beetle populations were light in full attacks and so light in basal fill-ins as to be of no importance. Woodpecker feeding on these larvae was light to moderate in early October.

The 1950-beetle populations have been greatly reduced by woodpecker feeding and cold temperatures, but a few scattered trees contained normal quantities of hibernating adults. Woodpecker feeding on the 1950-larvae was moderate to heavy.

About 1 mile west of this area are 35 1951-infested trees on the northwest slope of Porphory Mountain. The associated 1950-attacks contained no serious quantities of beetles. A few scattered groups of infested trees were also found west of Fulford, but no serious concentrations were seen.

Block 15--East Brush Creek

Acres	Full Attacks	Partial Attacks	Basal Fill-ins
315	1,510 ± 720	280 ± 130	280 ± 170

This infestation lies in the small drainage southeast of Hat Creek. The concentration of 1951-attacks was found along the lower portion of the creek, with only a few trees scattered along the slopes. The heavy invasion of beetles into this area took place in 1951; very few 1950-attacks were found.

The 1951-beetle populations appeared normal and were being fed upon by woodpeckers in September.

Adequate green spruce remains in the area to absorb any beetle flight in 1952.

Block 16--Mount Eve

Acres	Full Attacks	Partial Attacks	Basal Fill-ins
20	300 ± 80	80 ± 25	110 ± 45

Twenty acres of spruce at the top of the north slope of Mount Eve are infested by beetles which attacked during the past two summers.

The 1951-beetle populations in full and partial attacks were normal; populations in basal fill-ins were light. Woodpecker feeding was light to moderate.

The 1950-beetle populations have been greatly reduced by cold temperatures and other natural factors, but scattered trees were found containing many hibernating adults; 430 ± 100 treatable 1950-attacks were found. Woodpecker feeding on the 1950-beetles was moderate.

Very little green spruce remains in the area, and it is expected that some beetles will fly from Mount Eve in 1952.

Block 17--Hardscrabble Mountain

Acres	Full Attacks	Partial Attacks	Basal Fill-ins
718	3,550 ± 2,370	140 ± 100	720 ± 620

Trees Treated in 1950	Estimate of Trees to Treat in 1951	1950-1951 Winter Mortality of Larvae, in Percent	Trees Treated in 1951
206,213	98,700	78.45 ± 2.66	75,174

The outbreak on Hardscrabble Mountain has been brought under control by the treating work carried on in 1950 and 1951. Only a small number of trees will require treatment in 1952. These trees are located north of Mt. McKenzie.

The 1951-beetle populations were not heavy and woodpeckers had concentrated their feeding on the larvae in September.

Very few 1950-infested trees were seen outside the 1950-treating areas.

The only green spruce left on Hardscrabble Mountain is northeast of Mt. McKenzie.

Block 18--Red Table Mountain

Acres	Full Attacks	Partial Attacks	Basal Fill-ins
16,370	57,130 ± 8,330	15,400 ± 2,230	55,490 ± 6,380

Trees Treated in 1950	Estimate of Trees to Treat in 1951	1950-1951 Winter Mortality of Larvae, in Percent	Trees Treated in 1951
58,831	476,000	81.87 ± 1.66	1,916

The outbreak has been greatly reduced in size and intensity from that found in 1950. The main portion of the 1951-flight settled in the area between Red Creek and the west end of the mountain, both in the cirques and on the table top. Control operations against 1949-attacks in the head of the North Fork of Cattle Creek aided considerably in lessening the 1951-flight.

The 1951-beetle populations were normal in full attacks, but light in partial and basal fill-ins.

While a great reduction in the number of 1950-hibernating adults has taken place, many trees between Deadhorse Park and Iola Creek still contained quantities of beetles which may fly in 1952. The woodpecker feeding on 1950-beetle populations has been generally moderate throughout the length of the mountain, somewhat heavier toward the west end.

Parasitism was observed on many of the 1950-larvae.

Very little green spruce remains on the western end of Red Table Mountain in the vicinity of the North Fork of Cattle Creek and in the cirques east to Sourdough Creek.

Some trap-trees have been felled by the logger in Taylor Creek and by the Forest Service in the area northwest of the head of Cattle Creek.

Scouting

Map 1 shows the area covered by scouting. No serious concentrations of 1950- or 1951-infested trees were found. The small outlying epidemics found in 1950 have been brought under control, either by artificial or natural means.

Castle Peak was scouted. This examination showed that no green spruce remained to be infested in 1951, and that woodpeckers, cold temperatures, and control operations had reduced the beetle populations in the small trees infested in 1950 to the point where survival was so low that any flight in 1952 would be of little consequence.

An avalanche toward the head of Main Gore Creek destroyed a small acreage (approximately 10 acres) of spruce forest but no infestation had developed in 1951. Only eight full 1950-attacks were found.

Some scattered, infested trees were found in Timber Creek, Mill Creek, and at the head of Elk Creek near Minturn, but in all cases reductions in beetle populations were noted and no serious infestations existed.

The 1950-infested trees toward the head of East Lake Creek and below Middle Lake were examined. Woodpecker feeding on the 1950-beetles was moderate to heavy and broods were well below normal. No serious 1951-flight entered the areas. From 217 plots taken, only two full 1951-attacks were found. The infestations in these creek bottoms were not serious.

SUMMARY

During 1951, approximately 2.4 million gross acres of land were examined for Engelmann spruce beetle infestations (see Map 1). The susceptible spruce type was scouted and all the epidemic areas were surveyed.

The Engelmann spruce beetle outbreak in Colorado, while still very serious in some areas, has been greatly reduced in size and intensity. The control program carried out in 1950 against beetles in 1949-attacked trees was instrumental in reducing the infestation in 1951. In most of the small epidemic areas which had harbored heavy beetle populations over a long period of time, woodpeckers had multiplied enough to reduce materially the numbers of beetles. Cold temperatures during the winter of 1950-51 also were very effective in reducing the outbreak in many of these areas to the point where artificial control can eliminate the epidemics within the next year and thereby reduce control operations to a maintenance level.

The Kremmling control area (all of the Routt National Forest north of U.S. Highway 40 and all of the Arapaho National Forest) contains approximately 100,000 1951-infested trees that will require treatment in 1952. Of this number, 64,000 trees are on the Routt National Forest from U. S. Highway 40 to Luna Lake. In many sections of this area the epidemic is still aggressive and capable of extending the destruction of spruce unless controlled by artificial methods.

The Eagle control area (White River National Forest) contains approximately 125,000 1951-infested trees that will require treatment in 1952. Of this number, 93,000 trees are on Red Table Mountain. Unless the aggressive infestations, particularly on the eastern end of Red and White Mountain and on the western end of Red Table Mountain, are brought under control in 1952, there is danger that more spruce losses will occur.

A control program in 1952 must be geared to treat 225,000 1951-infested spruce. It is expected that approximately 175,000 spruce will be infested in 1952 from beetles emerging from the untreated 1950-attacks. These trees should also be treated in 1952 in order to bring the outbreak under control. The total control program in 1952 should be directed against these 400,000 trees.

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1951

Engelmann Spruce Beetle Outbreak

1951
ESTIMATES
ENGELMANN SPRUCE BEETLE OUTBREAK IN COLORADO

Number of 1951 Infested Spruce

Block	Name	Acres	Full Attacks	Partial Attacks	Basal Fill-ins
1	U.S. 40 to Luna Lake	36,200	39140 ± 6270	9780 ± 2190	42360 ± 7630
2	Chimney Rock	1,330	280 ± 80	440 ± 210	2500 ± 430
3	Elk Mtn.	2,344	1960 ± 350	1030 ± 260	4640 ± 980
4	Williams Ridge	2,990	2000 ± 450	1490 ± 270	4180 ± 1100
5	Surprise Lake	1,280	850 ± 270	630 ± 120	920 ± 390
6	Elliot Creek	4,218	1690 ± 1010	840 ± 227	2100 ± 590
7	Cottonwood Peak	7,574	8630 ± 1970	5300 ± 1244	14400 ± 3940
8	Meadow Creek	973	1670 ± 505	640 ± 155	550 ± 230
9	Red & White Mountain	3,557	5650 ± 920	4840 ± 960	6080 ± 1100
10	Stone Creek	870	530 ± 220	350 ± 140	260 ± 150
11	Beaver Lake	795	4680 ± 1110	1330 ± 470	950 ± 300
12	West L.—East L.	300	1060 ± 360	625 ± 230	690 ± 110
13	Squaw Creek	524	315 ± 130	315 ± 140	545 ± 60
14	Triangle Park	337	200 ± 30	0 ± 0	0 ± 0
15	East Brush Creek	315	1510 ± 720	280 ± 130	280 ± 170
16	Mount Eve	20	300 ± 80	80 ± 25	110 ± 45
17	Hardscrabble Mountain	718	3550 ± 2370	140 ± 100	720 ± 620
18	Red Table Mountain	16,370	57130 ± 8330	15400 ± 2230	55490 ± 6380
	Total	80,615	131135 ± 11190	43510 ± 2860	136775 ± 7850

Total 1951 full attacks	131,135	
Total 1951 partial attacks	43,510	
	174,645	
Total rounded to		175,000
Approximately one-third of the 136,775 fill-ins will need to be treated in 1952. The light broods in the remaining two-thirds of these trees will be further reduced by natural factors and will not need treatment.		50,000
Total 1951 trees to treat in 1952		225,000

Routt Natl Forest
Roosevelt National Forest
Rocky Mtn Natl Park
Arapaho Natl Forest
White River Natl Forest
Colorado River
Gunnison National Forest

1942 and 1949
Spruce & Lodgepole Pine killed.
No longer a source of infestation.

Old outbreak.
Beetle population from this area moved northward.

1951
U.S. Dept of Agriculture
Bureau of Entomology and Plant Quarantine
ENGELMANN SPRUCE BEETLE OUTBREAK
IN COLORADO

= Epidemic Areas

3E-II-51